

ABSTRACT FOR SPRING 1995 MRS MEETING

Submitted to Symposium G

Symposium Title: Structure and Properties of Multilayered Thin Films



IN SITU HIGH VOLTAGE ELECTRON MICROSCOPY TECHNIQUE FOR THE STUDY OF DEFORMATION AND FRACTURE : MULTILAYER MATERIALS, M. A. Wall, T. W. Barbee, Jr. and T. P. Weihs, Chemistry and Materials Science Department, Lawrence Livermore National Laboratory, Livermore, CA, 94551.

A novel In Situ High Voltage Electron Microscopy experimental technique for the observation of tensile deformation and failure is presented. The importance of specimen preparation and design will be emphasized in the description of the experimental procedure. This technique is particularly well suited for in situ observation of the tensile deformation and failure of multilayer materials since the structural scale of these materials is well matched to HVEM capabilities. We present video recorded and still image observations of the deformation and failure of a copper/zirconium multilayer fabricated by planetary magnetron sputtering. The samples were prepared from free standing foils 125 μm thick containing 1440 bilayer pairs of copper (80 nm) and zirconium (9 nm). Both cross-section and plan view observations of deformation and fracture are reported. It is shown that the propagation of a ductile crack can be studied by this technique and that, as a result of the structural scale of the multilayer, the microscopic details of the fracture process are directly observable. Such observations are expected to substantially advance our understanding of the mechanical response of this new class of atomically engineered very high strength materials thereby enabling their technological application.

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